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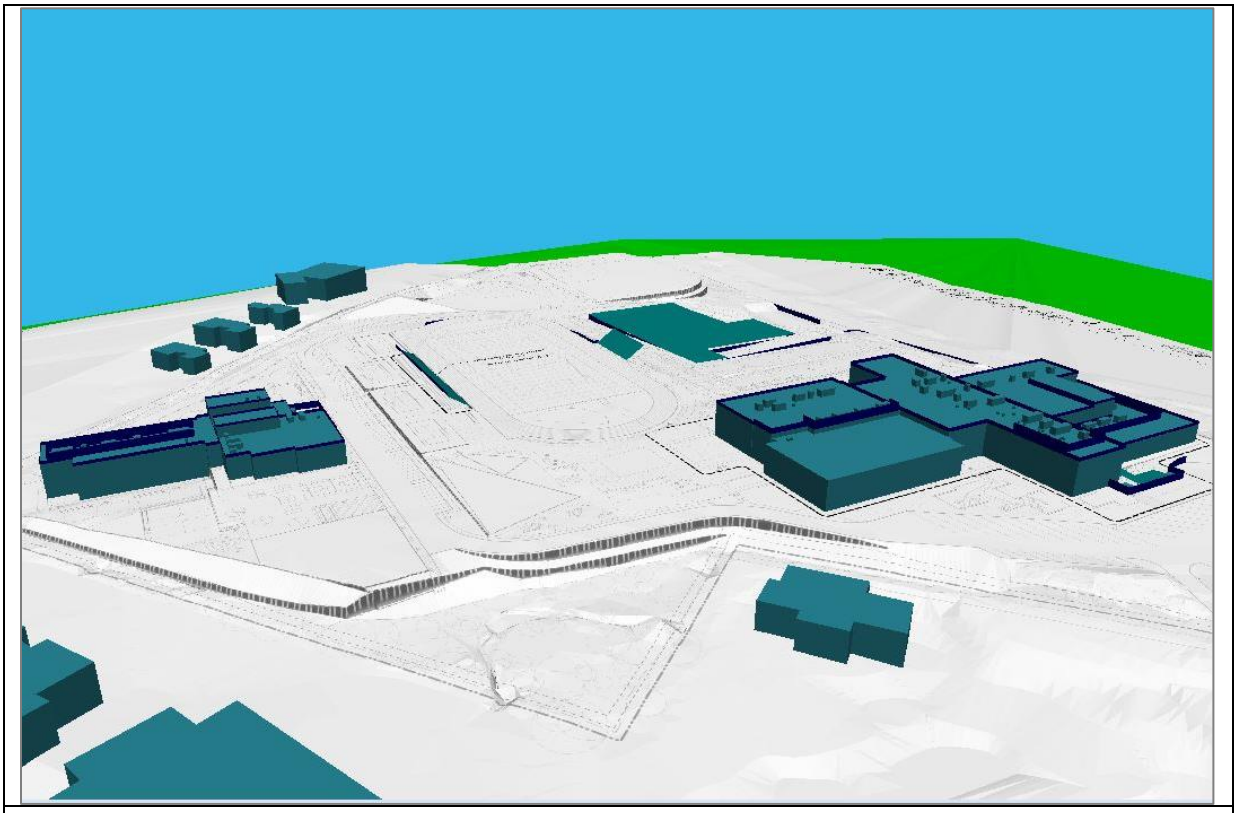

ISSAQUAH HIGH SCHOOL #4 AND ELEMENTARY #17 NOISE STUDY
ISSAQUAH, WASHINGTON

September 2, 2020

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INTRODUCTION

This Noise Study evaluates sound levels associated with the new High School (HS) #4 and Elementary School (ES) #17 project ("Project") located at 4221 228th Ave Southeast in Issaquah, Washington and is an update to the Draft Issaquah High School #4 and Elementary School #17 Noise Study issued in 2019. Project sound sources include stationary mechanical equipment, on-site traffic, a school bus lot, two loading docks, and a Scene Shop. Updates to rooftop mechanical equipment and on-site traffic routes are included in this Noise Study. This Noise Study also includes a discussion of compliance with local regulatory criteria, ambient sound level measurements, predicted sound levels at neighboring property lines, and recommend mitigation measures. A separate noise study was issued for the football stadium in October 2019.

SUMMARY

Based on the analysis presented in this Noise Study updated sound levels for stationary equipment and on-site traffic routes are anticipated to comply with Issaquah Municipal Code and Sammamish Municipal Code sound level limits and regulations with the addition of mitigation measured recommended in the Draft Issaquah High School #4 and Elementary School #17 Noise Study issued in 2019. Updated mitigation measures include a recommendation for pre-trip checks in the school bus lot to not occur between 10:00 PM and 7:00 AM.

NOMENCLATURE

Decibel

The auditory response to sound is a complex process that occurs over a wide range of frequencies and intensities. Decibel levels, or "dB," are a form of shorthand that compresses this broad range of intensities with a convenient numerical scale. The decibel scale is logarithmic. For example, using the decibel scale, a doubling or halving of energy causes the sound level to change by 3 dB; it does not double or halve the sound loudness as might be expected.

The minimum sound level variation perceptible to a human observer is generally around 3-dB. A 5-dB change is clearly perceptible, and an 8 to 10 dB change is associated with a perceived doubling or halving of loudness. The human ear has a unique response to sound pressure. It is less sensitive to those sounds falling outside the speech frequency range. Sound level meters and monitors utilize a filtering system to approximate human perception of sound. Measurements made utilizing this filtering system are referred to as "A weighted" and are called "dBA". Common sound pressure levels are reported below in Table 1.

Table 1. A-weighted Levels of Common Sounds

Sound	Sound Level (dBA)	Approximate Relative Loudness[1]
Jet Plane @ 100 feet	130	128
Rock Music with Amplifier	120	64
Thunder, Danger of Permanent Hearing Loss	110	32
Boiler Shop, Power Mower	100	16
Orchestral Crescendo at 25 feet	90	8
Busy Street	80	4
Interior of Department Store	70	2
Ordinary Conversation @ 3 feet	60	1
Quiet Car at Low Speed	50	1/2
Average Office	40	1/4
City Residence, Interior	30	1/8
Quiet Country Residence, Interior	20	1/16
Rustle of Leaves	10	1/32
Threshold of Hearing	0	1/64

1. As compared to ordinary conversation at 3 feet.

Source: US Department of Housing and Urban Development, Aircraft Noise Impact Planning Guidelines for Local Agencies, November 1972.

Metrics

- **Equivalent Sound Level, L_{eq}**
  L_{eq} is the A-weighted level of a constant sound having the same energy content as the actual time-varying level during a specified interval. The L_{eq} is used to characterize complex, fluctuating sound levels with a single number. Typical intervals for L_{eq} are hourly, daily and annually.
- **Sound Pressure Level, SPL**
  Sound pressure level correlates with what is heard by the human ear. SPL is defined as the squared ratio of the sound pressure with reference to 20 µPa. Sound pressure is affected by distance, path, barriers, directivity, etc.
- **Sound Power Level, L_wA**
  Sound power is the amount of energy per second generated by a source, measured in watts. The sound power level (L_wA) is a decibel representation with a reference value of 1 pico-watt (pW). Sound power is independent of distance, path, or influence from any nearby surfaces.

REGULATORY CRITERIA

Noise emissions from the Project are governed by the Issaquah Municipal Code (IMC), Sammamish Municipal Code (SMC), and Washington Administrative Code (WAC).

Issaquah Municipal Code

IMC Chapter 18.07.136 adopts, by reference, the Washington Administrative Code (WAC) Chapters 173-60-020 through 173-60-050:

IMC Chapter 18.07.136.B specifically limits sound levels from mechanical equipment to those listed in WAC 173-60-040. IMC Chapter 18.07.136.C provides an exemption from sound limits

during emergency situations as defined by the City's Comprehensive Emergency Management Plan.

Chapter 9.22.101 classifies noise as a public disturbance. A public disturbance Noise is defined as a person causing noise, or any person in possession of property allowing noise to originate from the property. The following sounds are determined to be public disturbance noises:

- The frequent, repetitive or continuous sounding of any horn or siren attached to a motor vehicle, except as a warning of danger or as specifically permitted or required by law;
- The creation of frequent, repetitive or continuous sounds in connection with the starting, operation, repair, rebuilding or testing of any motor vehicle, motorcycle, off-highway vehicle or internal combustion engine within a residential district so to unreasonably disturb or interfere with the peace, comfort and repose of owners or possessors of real property;
- Yelling, shouting, hooting, whistling or singing on or near the public streets, particularly between the hours of 11:00 PM and 7:00 AM or at any time and place so as to unreasonably disturb or interfere with the peace, comfort and repose of owners or possessors of real property;
- The creation of frequent, repetitive or continuous sounds which emanate from any building, structure, apartment or condominium, which unreasonably interferes with the peace, comfort and repose of owners or possessors of real property, such as sounds from musical instruments, audio sound systems, band sessions or social gatherings;
- Sound from any motor vehicle audio sound systems, such as tape players, radios and compact disc players, operated at volumes so as to be audible greater than 50 feet from the vehicle itself;
- Frequent, repetitive or continuous noise made by any animal which unreasonably disturbs or interferes with the peace, comfort and repose of property owners or possessors, except that such sound shall be exempt when originating from lawfully operated animal shelters, kennels, pet shops and veterinary clinics;
- The use of a sound amplifier or other device capable of producing or reproducing amplified sound on public streets for the purpose of commercial advertising or sales or for attracting the attention of the public to any vehicle, structure or property or the contents therein, except that vendors whose sole method of selling is from a moving vehicle shall be exempt from this subsection;
- Sound from portable audio equipment, such as tape players, radios and compact disc players, operated a volume so as to be audible greater than 50 feet from the source, and if not operated upon the property of the owner;

The foregoing provisions shall not apply to regularly scheduled events at parks, such as public address systems for baseball games or park concerts.

Sammamish Municipal Code

Although the Project is located within the City of Issaquah, properties located east of 228th Avenue Southeast are within the City of Sammamish. Sounds produced by the Project that are received within the City of Sammamish are subject to City of Sammamish regulatory criteria. Noise emissions within the City of Sammamish are regulated under SMC Chapter 8.15. The code addresses noise as a public disturbance with similar language as the IMC.

Since SMC does not quantify sound level limits, regulatory criteria for the City of Sammamish will be sound level limits established by WAC. These limits are applied at the property line of the receiving properties within the City of Issaquah and the City of Sammamish.

Washington Administrative Code

Permissible noise levels established in the State of Washington Administrative Code (WAC) 173-60 are defined by the environmental designation for noise abatement (EDNA) of the area, which is based upon present, future and historical use land use. WAC 173-60-030 defines the EDNA classifications as follows:

- Class A EDNA – "Lands where human beings reside and sleep." Typically, the following types of property are included:
  - Residential
  - Multiple family living accommodations
  - Recreational and entertainment (camps, parks, camping facilities, and resorts)
- Class B EDNA – "Lands involving uses requiring protection against noise interference with speech." Typically, these properties include the following:
  - Commercial living accommodations
  - Commercial dining establishments
  - Motor vehicle services
  - Retail services
  - Banks and office buildings
  - Miscellaneous commercial services, property not used for human habitation
  - Recreation and entertainment, property not used for human habitation (theaters, stadiums, fairgrounds, and amusement parks)
  - Community services, property not used for human habitation (**educational**, religious, governmental, cultural, and recreational facilities)
- Class C EDNA – "Lands involving economic activities of such a nature that higher noise levels than experienced in other areas is normally to be anticipated." Typically, these properties include the following:
  - Storage, warehouse, and distribution centers
  - Industrial property used for the production and fabrication of durable and nondurable manmade goods
  - Agricultural and silvicultural property used for the production of crops, wood products, or livestock

The maximum permissible hourly sound levels associated with the various EDNA classifications are shown in Table 2.

Table 2. Maximum Permissible Sound Levels, dBA

EDNA of Source Property	EDNA of Receiving Property		
	Class A	Class B	Class C
Class A	55	57	60
Class B	57	60	65
Class C	60	65	70

Source: WAC Chapter 173-60

Modifications to the sound level limits set forth in Table 2 are provided in WAC 173-60-040 and include the following:

- Sound levels are reduced by 10 dB between the hours of 10:00 PM and 7:00 AM for Class A EDNA receiving properties
- Sound level increases for short durations for any receiving property at any time as follows:
  - 5 dB for a total of 15 minutes in any one-hour period; or
  - 10 dB for a total of 5 minutes in any one-hour period; or
  - 15 dB for a total of 1.5 minutes in any one-hour period

WAC 173-60-050-3.f exempts sounds created by emergency equipment and work necessary in the interests of law enforcement or for the health, safety or welfare of the community from the WAC 173-60-040 sound level limits.

Because the Project will be used for educational purposes the property is considered a Class B EDNA, resulting in the maximum permissible sound levels provided in Table 3.

Table 3. Maximum Permissible Sound Levels, dBA

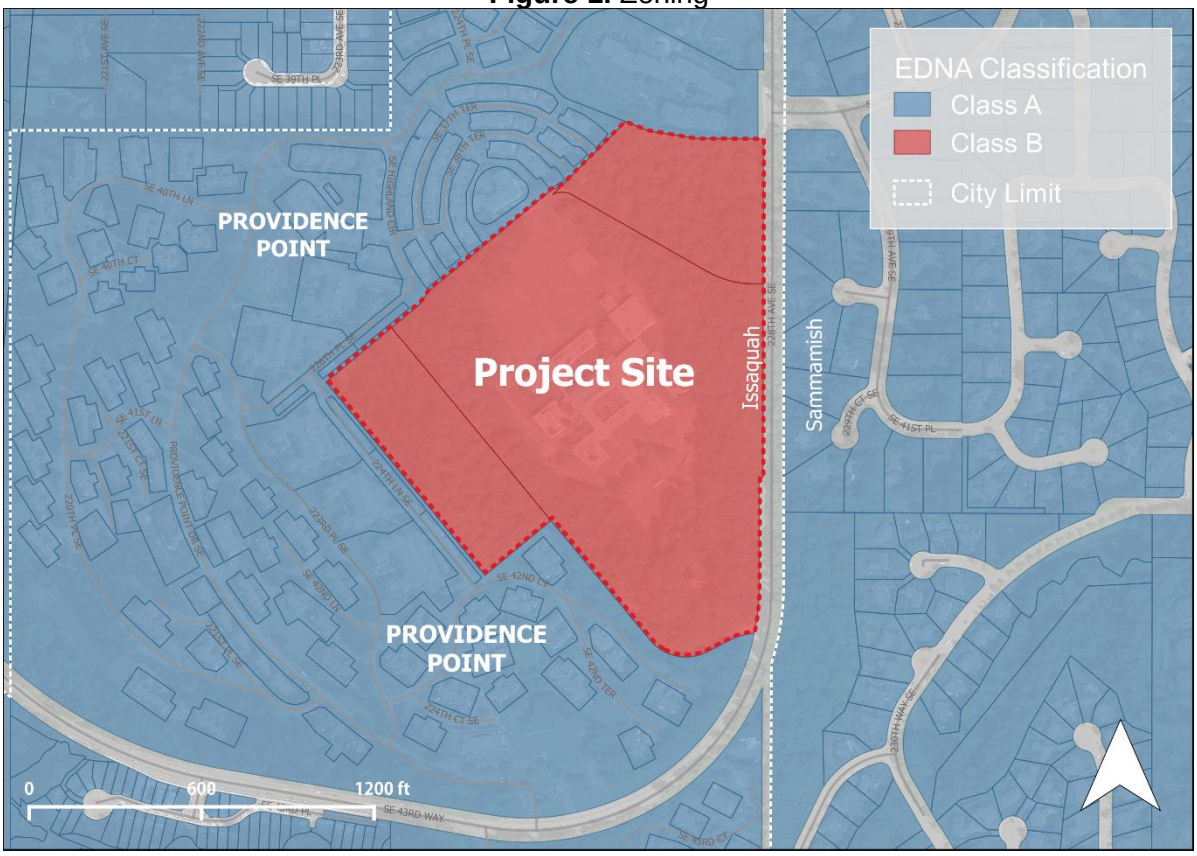
EDNA of Source Property	WAC Daytime Sound Level Limits	WAC Nighttime Sound Level Limits
North	57	47
South		
East		
West		

Source: WAC Chapter 173-60

Zoning

The Project is located within the City of Issaquah. The City of Sammamish borders the Project to the east. A retirement community (Providence Point) is located along the Project's north, west, and south property boundaries. Single-Family Residential homes are located east of the Project in the City of Sammamish. All properties adjacent to the Project are Class A EDNA. The EDNA classifications of the Project and nearby properties are illustrated in Figure 1 below.

Figure 1. Zoning

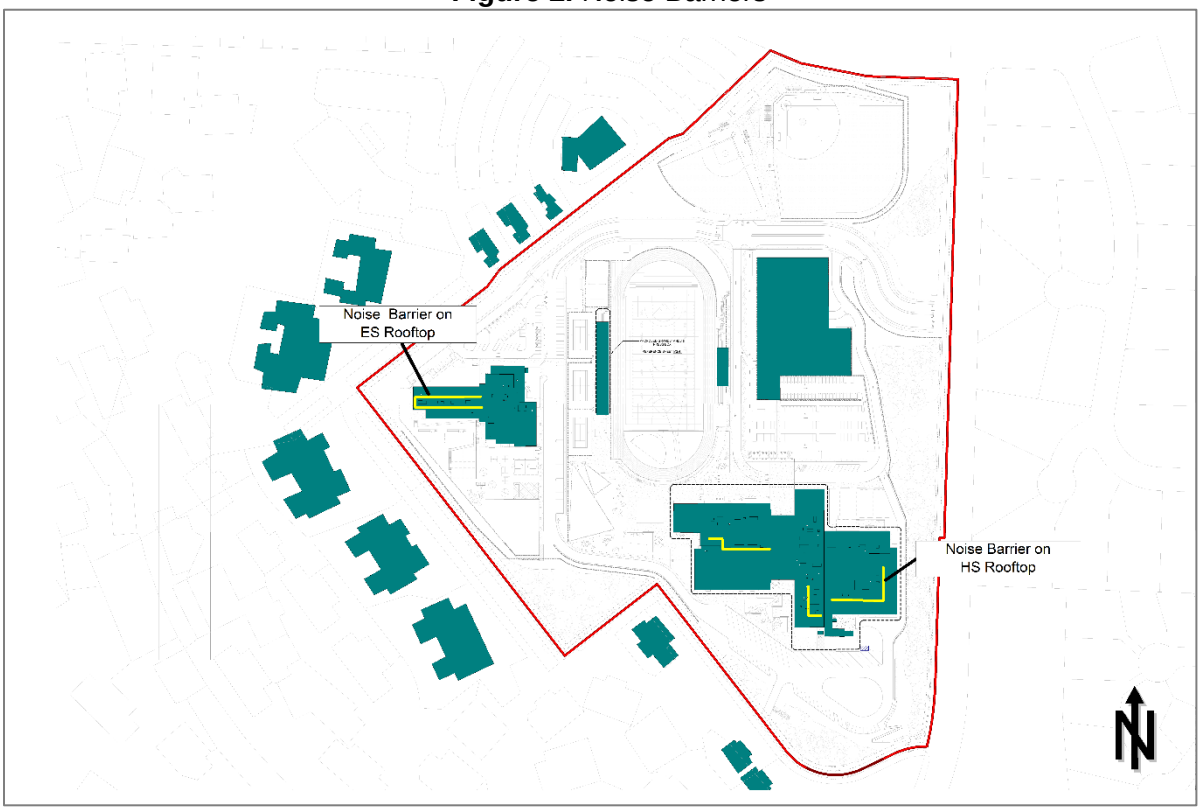


ACOUSTICAL MODEL

The primary tool used to predict sound levels from the Project at neighboring property lines were 3-D computer noise models created using the acoustic modeling software environment Cadna/A. Cadna/A utilizes the CADNA (Control of Accuracy and Debugging for Numerical Applications) computation engine developed by the Pierre et Marie Curie University of Paris. The models used for this Project utilized the International Organization for Standardization 9613 Part II algorithms, implemented in the Cadna/A software, which accounted for the effects of distance, topography, and surface reflections on sound levels.

Locations of structures and electrical equipment were determined from drawings provided by Bassetti Architects. On-site elevation contours were provided by AHBL. Rooftop mechanical equipment locations were determined from drawings provided by Hargis Engineers. Off-site topography, parcel information, and EDNA designations were acquired online through the King County Geographic Information System (GIS) Center, the City of Issaquah Website, and the City of Sammamish Website. On-site vehicle and school bus traffic was modeled using predicted trip generation estimates provided by Heffron Transportation, Inc. Locations of rooftop acoustical barriers were based on drawings provided by Bassetti Architects and Hargis Engineers. Figure 2 shows the locations of noise barriers included in the model.

Figure 2. Noise Barriers



Noise Sources

Several types of noise sources will be present at the Project site, including noise generated by stationary equipment, on-site traffic, the school bus lot, two loading docks, and the Scene Shop.

Stationary Mechanical Equipment

Stationary equipment located at the HS and ES includes air handling units (AHU), exhaust fans (EF), kitchen exhaust fans (KEF), fume exhaust fans (FEF), condensing units (CU), one generator, one compactor, and a 3,750 KVA transformer at the HS and 300 KVA transformer at the ES. Sound data for the AHUs, EFs, KEFs, FEFs, and CUs were obtained from sound power levels provided by Hargis Engineers. Sound data for AHU 104, AHU 204, AHU 209, and AHU 402 at the HS and AHU 102 and AHU 306 at the ES was estimated from CFM ratings. Sound levels for the AHUs are based on radiated sound levels, unless otherwise stated. Sound data used to model the EFs, KEFs, FEFs, and CUs were based on inlet sound data. The NEMA Standard Publication No. TR 1-1993 (R200) was used to estimate the sound levels from the two transformers. Bassetti Architects provided sound data for the Generator. Sound data for the compactor located at the HS was estimated based on sound data collected from similar compactors. Modeled sound power levels for the equipment are listed in Table 4 and Table 5. Locations of the modeled equipment are shown in Figure 3 and Figure 4.

Table 4. Stationary Equipment Sound Power Levels at the High School, dB re: 1 pW

Stationary Equipment	Frequency, Hz								L_wA
	63	125	250	500	1,000	2,000	4,000	8,000	
AHU									
AHU 102	80	74	76	76	75	72	73	65	**84**
AHU 103	80	74	76	76	75	72	73	65	**84**
AHU 104	79	83	82	74	69	64	59	59	**87**
AHU 105	44	78	83	88	88	86	85	82	**94**
AHU 106	80	74	76	76	75	72	73	65	**84**
AHU 107	85	85	81	78	76	71	64	57	**89**
AHU 108	80	74	76	76	75	72	73	65	**84**
AHU 109A/B	44	78	83	88	88	86	85	82	**94**
AHU 110	80	74	76	76	75	72	73	65	**84**
AHU 201	80	74	76	76	75	72	73	65	**84**
AHU 202	80	74	76	76	75	72	73	65	**84**
AHU 203	85	85	81	78	76	71	64	57	**89**
AHU 204	79	83	82	74	69	64	59	59	**87**
AHU 205A	44	78	83	88	88	86	85	82	**94**
AHU 205B	44	78	83	87	88	86	86	82	**94**
AHU 206	80	74	76	76	75	72	73	65	**84**
AHU 207	80	74	76	76	75	72	73	65	**84**
AHU 208	85	85	81	78	76	71	64	57	**89**
AHU 209	79	83	82	74	69	64	59	59	**87**
AHU 301	44	78	83	88	88	86	85	82	**94**
AHU 302	85	85	81	78	76	71	64	57	**89**
AHU 303	44	78	83	88	88	86	85	82	**94**
AHU 304	85	85	81	78	76	71	64	57	**89**
AHU 401	44	78	83	88	88	86	85	82	**94**
AHU 402	79	83	82	74	69	64	59	59	**87**
AHU 403	85	85	81	78	76	71	64	57	**89**
AHU 404	80	74	76	76	75	72	73	65	**84**
AHU 405	80	74	76	76	75	72	73	65	**84**
AHU 406	85	85	81	78	76	71	64	57	**89**
AHU 407	85	85	81	78	76	71	64	57	**89**
AHU 408	80	74	76	76	75	72	73	65	**84**
AHU 409	80	74	76	76	75	72	73	65	**84**
EF									
EF 101	77	75	71	73	68	67	63	59	**81**

Stationary Equipment	Frequency, Hz								L_wA
	63	125	250	500	1,000	2,000	4,000	8,000	
EF 102	81	77	76	70	63	62	58	54	**84**
EF 103	71	71	71	63	57	57	51	46	**76**
EF 203	71	69	66	61	58	57	52	42	**74**
EF 204	69	75	69	65	64	60	55	50	**77**
EF 301	74	73	75	71	64	60	57	52	**80**
EF 401	77	75	71	73	68	67	63	59	**81**
EF 402	78	69	63	56	50	49	42	35	**79**
FEF									
FEF 301	72	67	63	55	52	52	40	35	**74**
FEF 302	72	67	63	55	52	52	40	35	**74**
FEF 303	72	67	63	55	52	52	40	35	**74**
FEF 304	72	67	63	55	52	52	40	35	**74**
FEF 305	72	67	63	55	52	52	40	35	**74**
FEF 306	72	67	63	55	52	52	40	35	**74**
FEF 307	72	67	63	55	52	52	40	35	**74**
FEF 308	72	67	63	55	52	52	40	35	**74**
KEF									
KEF 301	81	77	79	72	65	63	60	56	**84**
KEF 302	79	77	81	71	66	64	61	56	**84**
KEF 303	74	72	75	67	61	62	56	51	**79**
CU									
CU 301	69	73	67	69	68	64	59	60	**72**
Other									
Generator[1]	-	-	-	-	-	-	-	-	**97**
Compactor[2]	-	-	-	-	-	-	-	-	**112**
Transformer[3]	-	-	-	-	-	-	-	-	**84**

1. Sound level of 72 dBA at 23 feet based on a generator sound data provided by Bassetti Architects
2. Estimated sound level of 80 dBA at a distance of 50 feet.
3. Sound level of 71 dBA at a distance of 20 feet based on NEMA Standards

Table 5. Stationary Equipment Sound Power Levels at the Elementary School, dB re: 1 pW

Stationary Equipment	Frequency, Hz								L_wA
	63	125	250	500	1,000	2,000	4,000	8,000	
AHU									
AHU 101	44	78	83	88	88	86	85	82	**94**
AHU 102	79	83	82	74	69	64	59	59	**87**
AHU 103	80	74	76	76	75	72	73	65	**84**
AHU 104	85	85	81	78	76	71	64	57	**89**
AHU 105	44	78	83	88	88	86	85	82	**94**
AHU 202	85	85	81	78	76	71	64	57	**89**
AHU 203	85	85	81	78	76	71	64	57	**89**
AHU 301	80	74	76	76	75	72	73	65	**84**
AHU 302	80	74	76	76	75	72	73	65	**84**
AHU 303	80	74	76	76	75	72	73	65	**84**
AHU 304	80	74	76	76	75	72	73	65	**84**
AHU 305	82	82	78	75	73	68	61	54	**86**
AHU 306	79	83	82	74	69	64	59	59	**87**
EF									
EF 101	76	72	69	62	54	55	49	35	**78**
EF 102	75	79	82	75	68	68	62	57	**85**
EF 104	79	77	64	56	52	45	36	35	**81**
EF 201	77	72	72	67	62	62	59	51	**80**
EF 202	71	80	78	71	64	68	58	52	**83**
EF 203	71	69	66	60	57	56	50	41	**74**
EF 301	71	74	68	61	59	57	49	46	**77**
EF 302	68	68	61	60	53	49	45	41	**72**
KEF									
KEF 201	75	76	77	75	68	64	58	51	**82**
KEF 202	73	71	71	66	62	61	56	48	**77**
CU									
CU 301	69	73	67	69	68	64	59	60	**72**
Other									
Transformer[1]	-	-	-	-	-	-	-	-	**80**

1. Sound level of 67 dBA at a distance of 20 feet based on NEMA Standards

Figure 3. Stationary Equipment Modeled at the High School

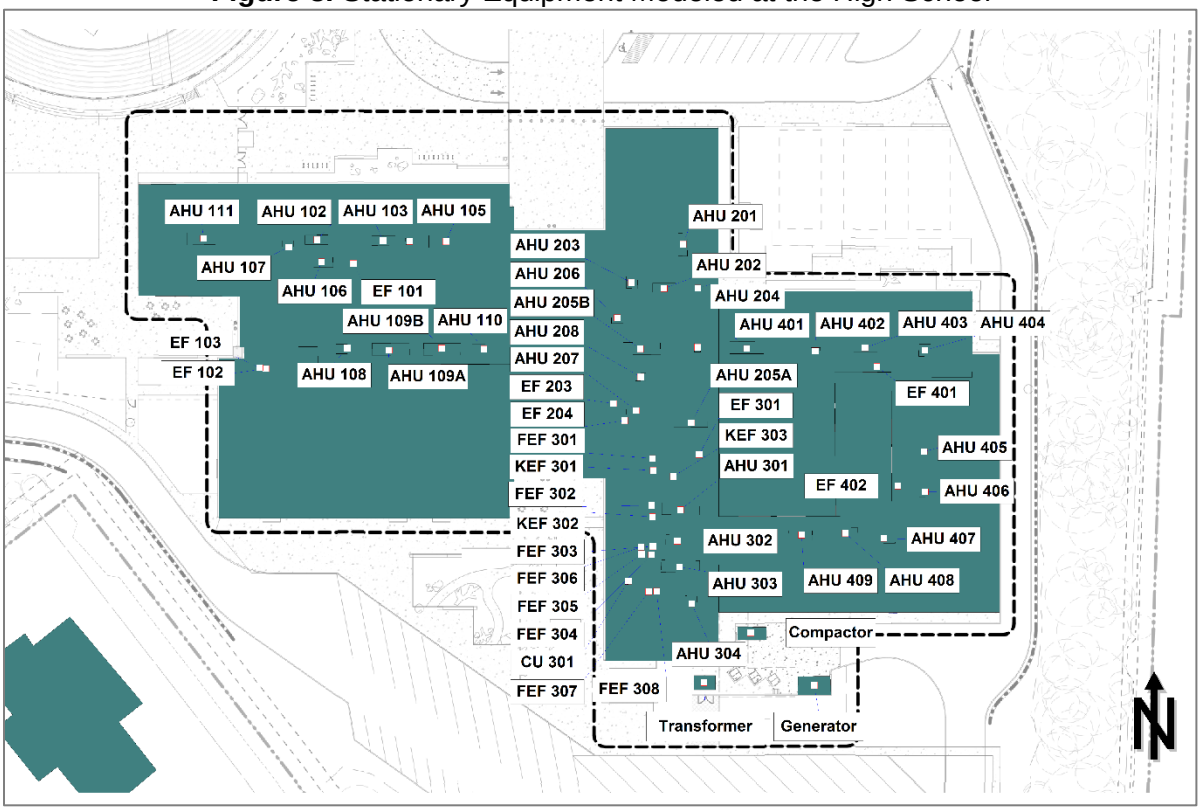
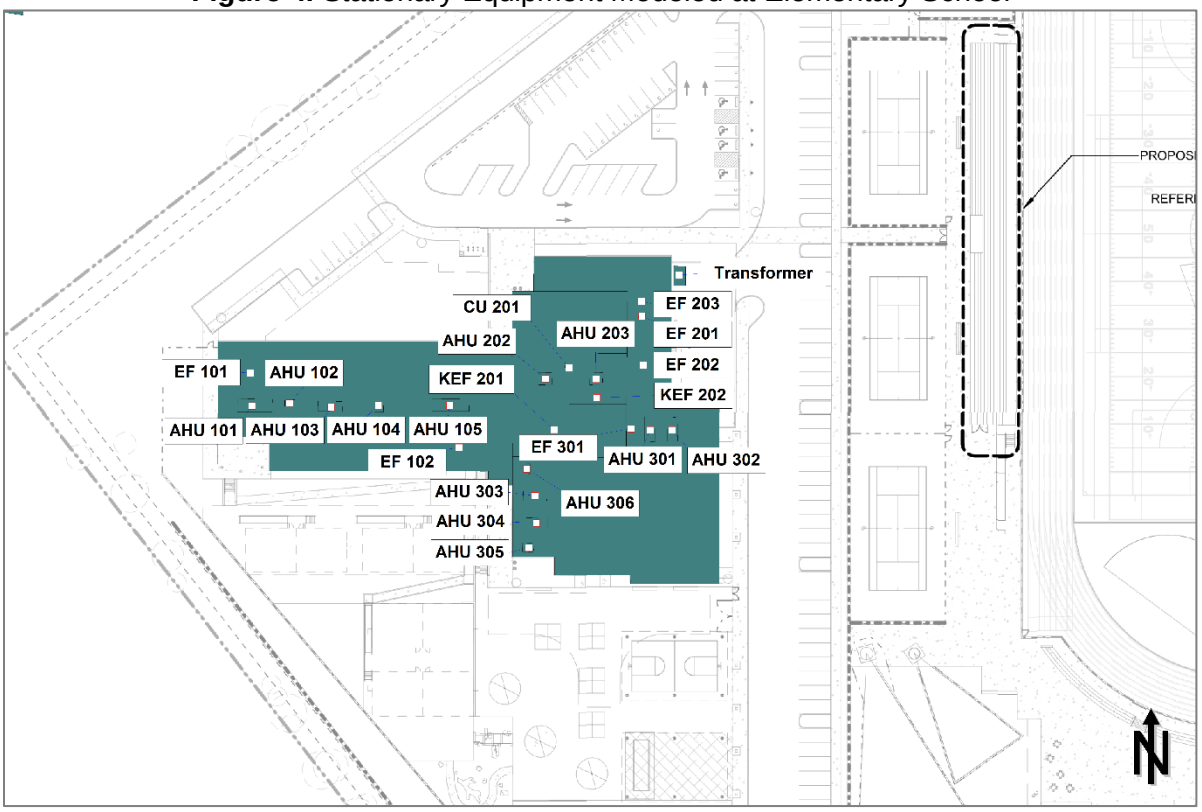


Figure 4. Stationary Equipment Modeled at Elementary School



On-Site Traffic

On-site vehicle and school bus traffic was modeled using predicted trip generation estimates provided by Heffron Transportation, Inc. Traffic data used in the computer noise models consist of peak daytime and nighttime hours. The peak nighttime hour at the HS and ES is 6:00 AM to 7:00 AM. Daily trips for the HS and ES do not coincide with each other because the schools have different start times. Due to this, peak hours for the HS and ES were modeled separately. The peak daytime hour at the HS is 7:00 AM to 8:00 AM, while the peak daytime hour at the ES is from 8:15 AM to 9:15 AM.

In addition to vehicles and school buses, one commercial delivery vehicle is anticipated to enter and exit the property to service both schools daily. The commercial delivery vehicle was modeled during peak daytime HS and ES hours.

Table 6 below lists trip generation estimates for 6:00 AM to 7:00 AM, 7:00 AM to 8:00 AM, and 8:15 AM to 9:15 AM. Estimates were adjusted from the Heffron report to show the approximate traffic volume for each anticipated traffic route.

Table 6. Modeled Trip Generation Estimates, Vehicles Per Hour

Traffic Routes	6:00 AM – 7:00 AM (Peak Nighttime)	7:00 AM – 8:00 AM (Peak Daytime HS)	8:15 AM – 9:15 AM (Peak Daytime ES)
HS Passenger Load Inbound	18	344	12
HS Passenger Load Outbound	18	344	12
HS Parking Inbound	12	309	8
ES Passenger Load Inbound	-	59	147
ES Passenger Load Outbound	-	59	147
HS Employee Inbound	124	114	-
ES Employee Inbound	-	74	23
Bus Employee Inbound	30	-	-
Bus Employee Outbound	-	-	30
School Bus Inbound	-	30	6
School Bus Outbound	30	6	-
Commercial Inbound	-	1	1
Commercial Outbound	-	1	1

Traffic routes were based on drawings provided by Bassetti Architects. On-site traffic routes include HS passenger load inbound and outbound, ES passenger load inbound and outbound, HS parking inbound, HS employee parking inbound, ES employee parking inbound, school bus employee parking inbound and outbound, school bus inbound and outbound, and commercial inbound and outbound. Sound data from the Federal Highway Administration's Traffic Noise Model (FHWA TNM), Version 1.0 Technical Manual was used to model passenger and commercial haul vehicles. Sound data for school buses were based on measurements made by the Greenbusch Group. Table 7 list the sound levels for modeled traffic. Figure 5 and Figure 6 illustrate the anticipated traffic routes for the Project.

Table 7. Modeled Traffic Sound Power Levels, dB re:1 pW

Sound Source	Frequency, Hz								L_wA
	63	125	250	500	1,000	2,000	4,000	8,000	
Vehicle[1]	-	-	-	-	-	-	-	-	**82**
Commercial Haul[2]	-	-	-	-	-	-	-	-	**107**
School Bus	95	93	88	86	89	87	83	77	**93**

1. Sound level of 50 dBA at a distance of 50 feet based on TNM sound data.
2. Sound level of 75 dBA at a distance of 50 feet based on TNM sound data.

Figure 5. Modeled Traffic Routes

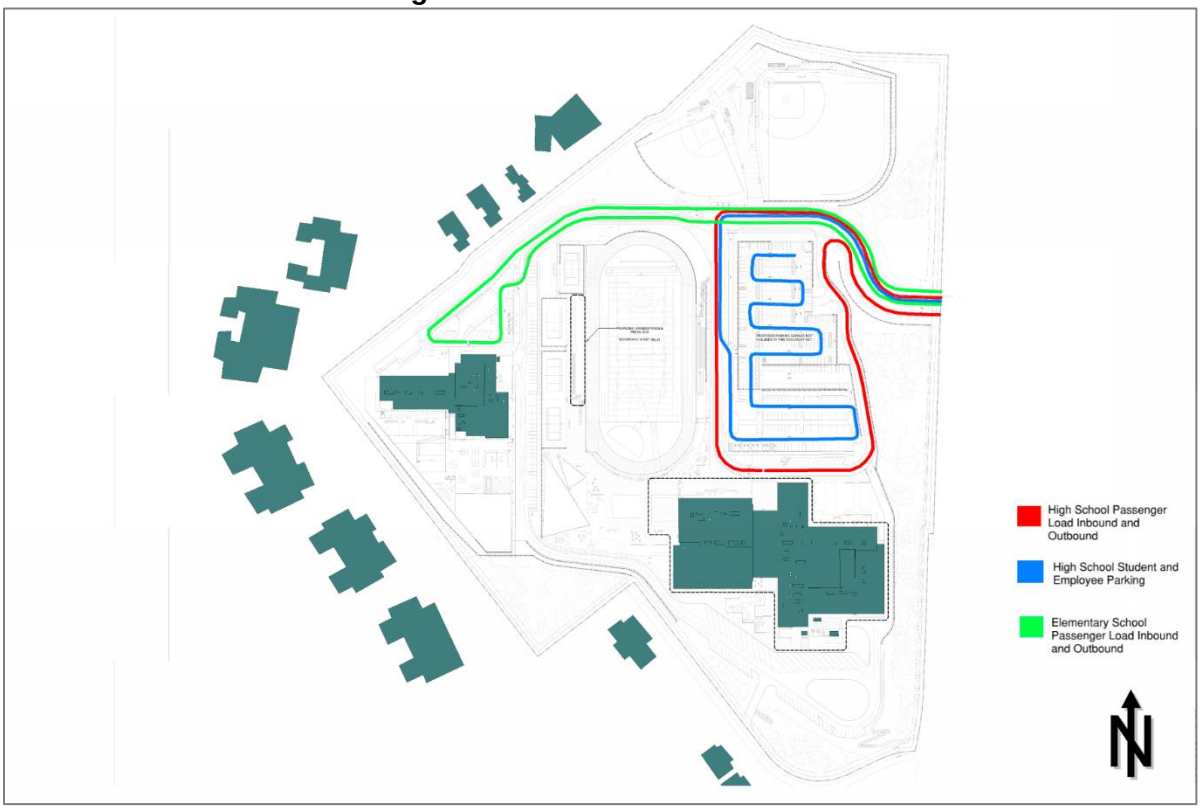
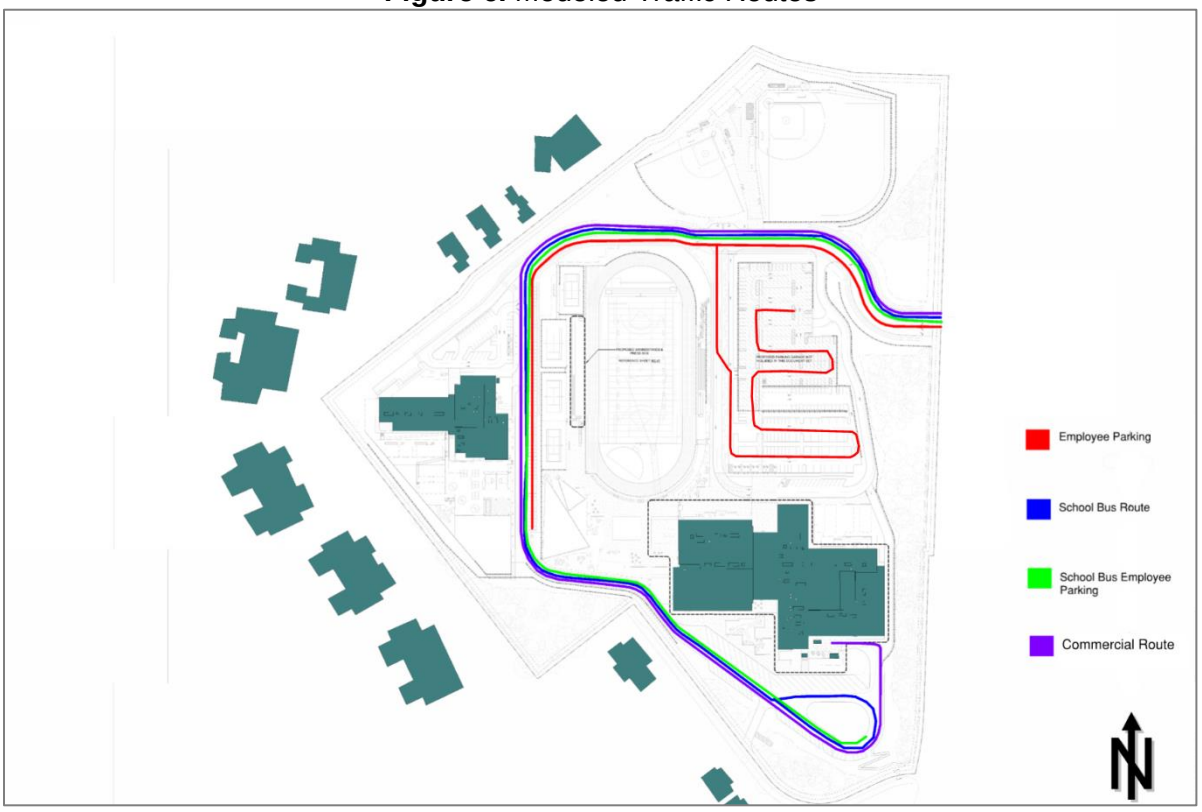


Figure 6. Modeled Traffic Routes



School Bus Lot, Loading Dock, and Scene Shop

Other sound sources that were modeled at the ES and HS include the bus lot, two loading docks, and the Scene Shop.

The HS and ES property will double as a school bus lot for buses servicing the two schools. Per WAC 392-145-041, pre-trip inspections are to take place prior to each bus trip. Pre-trip inspections include testing of all brakes, lights, stop signs, warning signals, and other safety devices. During these pre-trip inspections the bus brakes and back-up alarms will generate noise.

Both the HS and ES will have a loading dock with commercial vehicle activity. Sound sources from the loading docks will include commercial vehicle idling, backup alarms, and compression breaks.

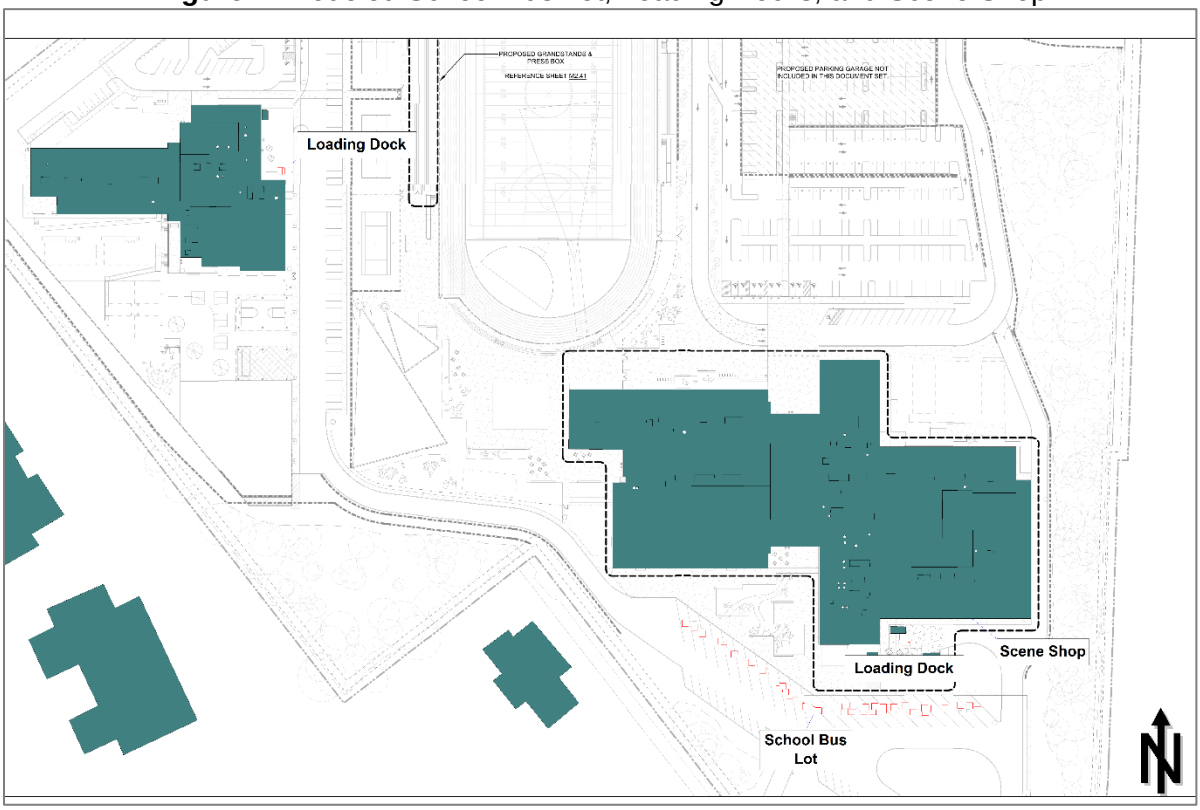
Noise from tools used inside the Scene Shop were also included in the noise models. For modeling purposes, it was assumed the Scene Shop's exterior rollup door was open. Tools modeled inside the Scene Shop include an air gun stapler, saw dust extractor, table saw, bench sander, portable sander, and a lathe.

Sound data for the school bus lot, commercial haul delivery loading dock, and Scene Shop are based on measurements made of similar equipment by the Greenbusch Group. Sound data for the school bus lot, loading dock, and Scene Shop are listed in Table 8 below.

Table 8. Modeled Sound Power Levels, dB re: 1 pW

Sound Source	Frequency, Hz								L_wA
	63	125	250	500	1,000	2,000	4,000	8,000	
School Bus Lot									
Brakes	95	94	90	87	106	91	93	93	**106**
Backup Alarm	98	100	90	87	99	81	77	70	**99**
Loading Dock									
Air Brakes	82	74	72	73	73	74	78	82	**84**
Idling	94	99	93	94	94	94	87	79	**99**
Backup Alarms	104	105	100	101	112	102	102	99	**113**
Scene Shop									
Air Gun Stapler	82	89	96	93	101	98	97	95	**105**
Saw Dust Extractor	86	82	84	81	75	87	84	73	**90**
Table Saw	90	96	87	85	84	92	95	91	**98**
Bench Sander	79	84	78	86	88	88	88	88	**94**
Portable Sander	77	76	89	94	89	91	84	78	**96**
Lathe	73	87	81	91	91	87	85	84	**95**

Figure 7. Modeled School Bus Lot, Loading Docks, and Scene Shop



ANALYSIS AND RESULTS

Three models were generated to predict nighttime and daytime sound levels. The nighttime model predicted sound levels for the peak nighttime hour (6:00 AM to 7:00 AM). The daytime model was split between peak traffic at the HS (7:00 AM to 8:00 AM) and peak traffic at the ES (8:15 AM to 9:15 AM). Because the schools start at different times, the Project will experience two different peak traffic hours that require separate models.

Nighttime

Sound levels from the Project were predicted 5 feet above grade at neighboring property lines. The model includes the rooftop mechanical equipment, the two transformers, on-site traffic, and pre-trip inspection activity at the school bus lot. Sounds produced by the two loading docks, generator, compactor, and Scene Shop where not modeled during nighttime hours.

Several nearby multistory residences may have line-of-sight to the screened rooftop mechanical units. Because areas near the ground do not always have line-of-sight to these units, sound levels were also predicted at multiple elevations at nearby residential structures to determine if predicted sound levels comply with codified sound limits at different elevations.

Table 9 lists predicted sound levels at neighboring property lines and buildings during peak nighttime hours. Sound levels exceed nighttime code at properties to the south of the Project due to pre-trip inspections at the school bus lot. Figure A1 in Appendix A illustrates predicted sound levels without mitigation at neighboring properties

Table 9. Predicted Unmitigated Nighttime Sound Levels, dBA

Property	Sound Level Limit	Predicted Sound Levels	Complies with Sound Limits?
North	47	28	Yes
Northeast		32	Yes
East		39	Yes
Southeast		39	Yes
South		53	No
Southwest		43	Yes
West		46	Yes
Northwest		41	Yes

Mitigation to reduce sound levels at the southern property line include prohibiting pre-trip bus inspections between 10:00 PM and 7:00 AM. Pre-trip bus inspections should not take place during these nighttime hours. Pre-trip inspections should only take place during daytime hours, between 7:00 AM and 10:00 PM.

The following Table shows predicted nighttime sound levels without noise generated from pre-trip inspections at the school bus lot.

Table 10. Predicted Peak Nighttime Sound Levels, dBA

Property	Sound Level Limit	Predicted Sound Levels without Mitigation	Predicted Sound Levels with Mitigation	Complies with Sound Limits
North	47	28	27	Yes
Northeast		32	32	
East		39	39	
Southeast		39	37	
South		53	45	
Southwest		43	40	
West		46	46	
Northwest		41	41	

As shown the Table above, mitigated sound levels produced by the Project are predicted to comply with codified nighttime sound level limits. Figure A2 in Appendix A illustrates predicted sound levels for peak nighttime hours at the HS and ES without the pre-trip inspections at the school bus lot.

Daytime

Two models where used to predict daytime sound levels at neighboring property lines during peak hours for the HS and ES. Each model included sound levels from rooftop mechanical equipment, two transformers, one generator, the pre-trip checks at the school bus lot, two loading docks, the Scene Shop, and on-site traffic. The only difference between the two models were traffic routes and traffic volumes (see Table 6).

Table 11 and Table 12 below list predicted sound levels from each peak daytime hour. Predicted sound levels did not exceed code limits during both peak hours for the HS and ES. Figure A3 and Figure A4 in Appendix A illustrate predicted sound levels for peak daytime hours at the HS and ES.

Table 11. Predicted Peak Daytime HS Sound Levels, dBA

Property	Sound Level Limit	Predicted Sound Levels	Complies with Sound Limits?
North	57	32	Yes
Northeast		36	
East		39	
Southeast		39	
South		53	
Southwest		45	
West		40	
Northwest		51	

Table 12. Predicted Peak Daytime ES Sound Levels, dBA

Property	Sound Level Limit	Predicted Sound Levels	Complies with Sound Limits?
North	57	31	Yes
Northeast		35	
East		47	
Southeast		39	
South		52	
Southwest		45	
West		40	
Northwest		50	

CONCLUSION

Based on this analysis detailed above, sound produced by updated stationary equipment and on-site traffic at the HS and ES are expected to comply with local regulatory criteria with the inclusion of recommended noise mitigation. To comply with nighttime sound level limits, pre-trip school bus inspections should not take place between 10:00 PM and 7:00 AM.

APPENDIX A. PREDICTED SOUND LEVELS

Figure A1. Predicted Nighttime Sound Levels with School Bus Lot Pre-Trip Noise Generation

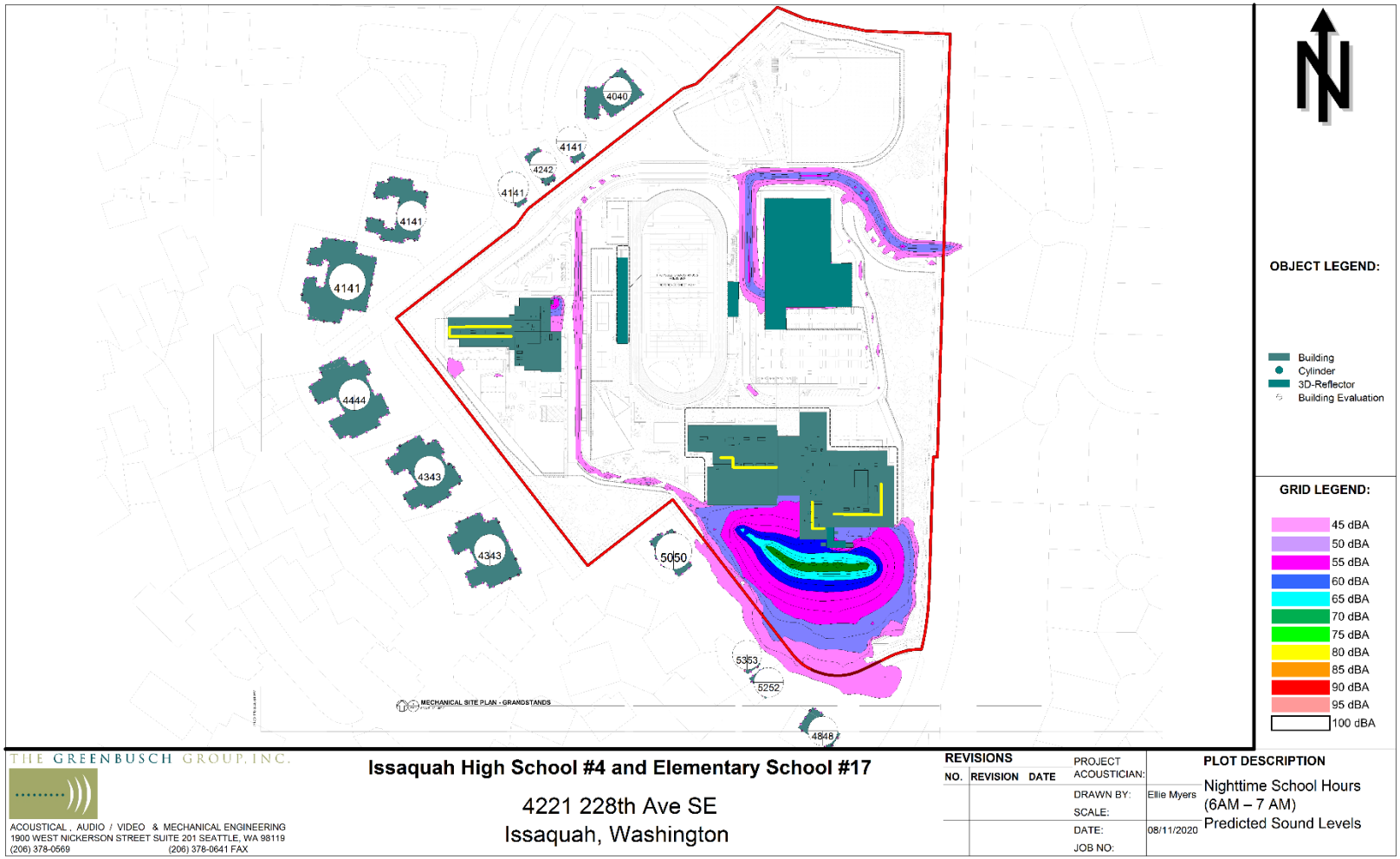


Figure A2. Predicted Nighttime Sound Levels without School Bus Lot Pre-Trip Noise Generation

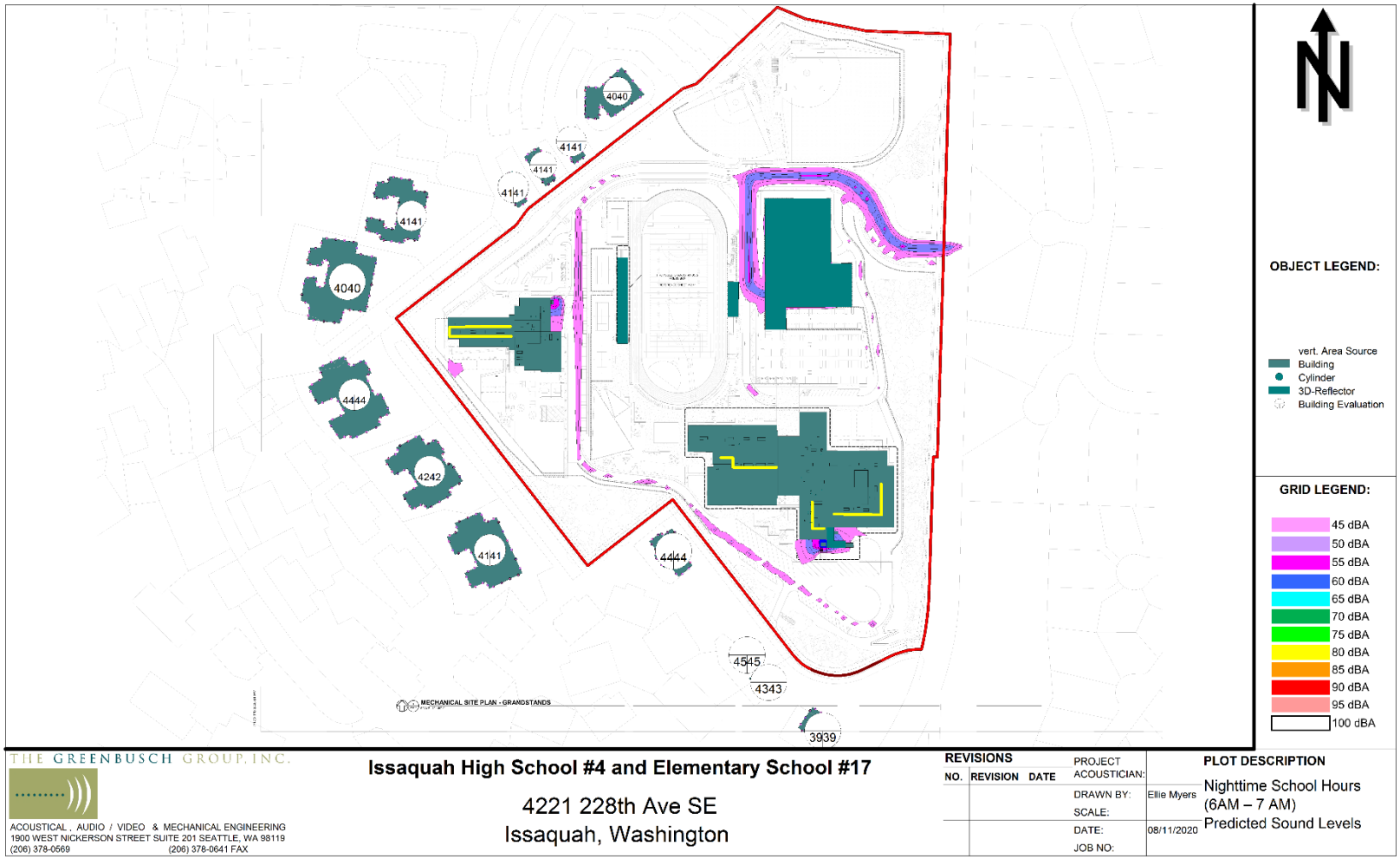


Figure A3. Predicted Peak Daytime HS Sound Levels

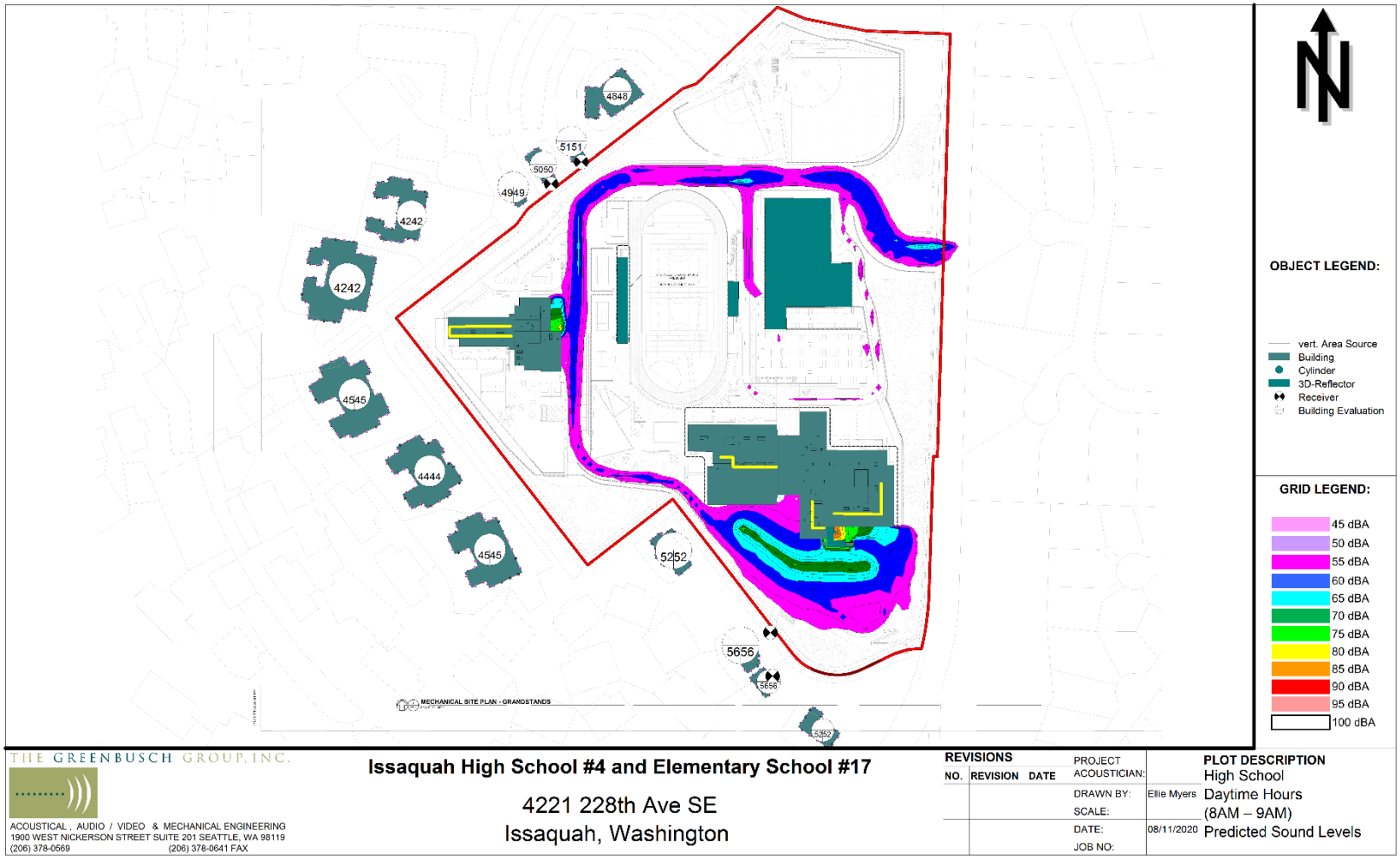
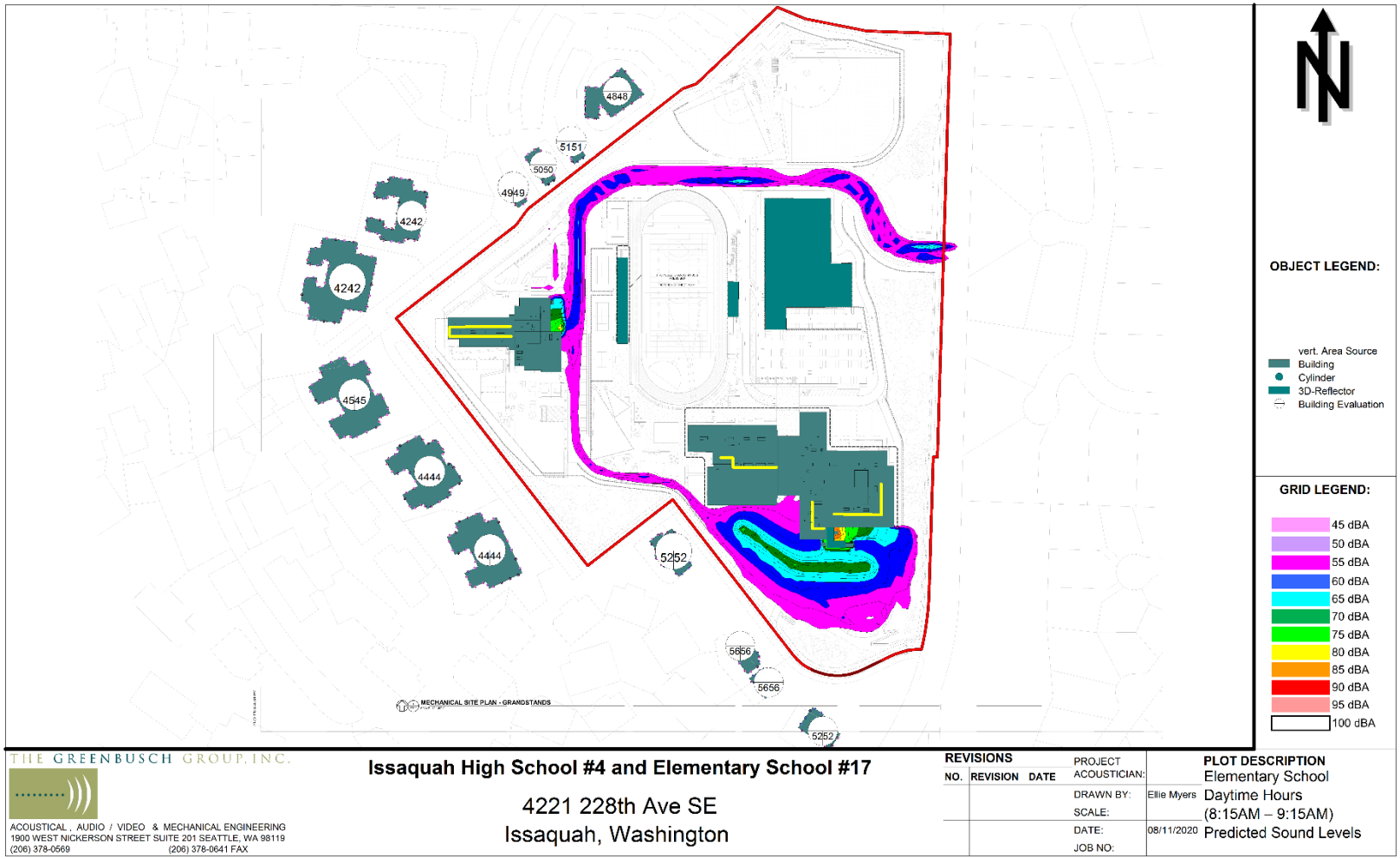


Figure A4. Predicted Peak Daytime ES Sound Levels



APPENDIX B. BASELINE NOISE MEASUREMENTS

The intent of this Appendix is to present a summary of baseline noise measurements made as part of the Issaquah High School #4 and Elementary School #17 Project ("Project").

BASELINE NOISE MEASUREMENTS

Continuous sound level measurements were made at two locations between Monday September 23, 2019 and Thursday September 26, 2019. However, due to an equipment malfunction, measurements at Location 1 were conducted Tuesday October 1, 2019 to Friday October 4, 2019. The intent of the measurements was to document existing background sound levels near the project site prior to construction to aid in the development of the Project's design criteria. Local noise sources included street traffic and birds.

Wind conditions between September 23 and September 26, 2019 averaged one to five miles per hour and came from the southeast and northwest. Temperatures ranged between 55-and-70-degrees Fahrenheit. Rain occurred during the measurements and ranged between 0.02 and 0.06 inches per day. Wind conditions between October 1 and October 4, 2019 averaged one to three miles per hour and were generally from the southeast. Temperatures ranged between 33-and 63- degrees Fahrenheit and rainfall was between 0 and 0.04 inches per day. The rain did not appear to significantly influence the measurement data but may have increased the ambient levels at measurement locations near roadways because of tire noise. Environmental windscreens were used on all microphones during the measurements.

Equipment used during the measurements is identified in Table B1 below.

Table B1. Measurement Equipment

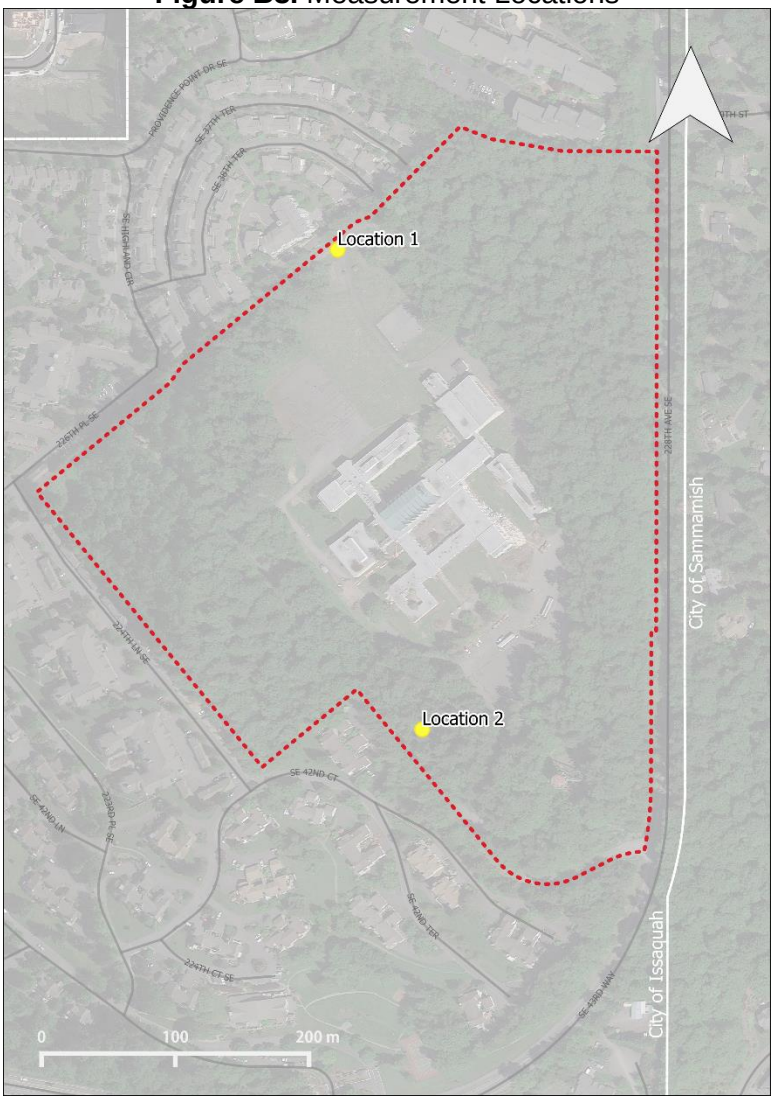
Make and Model	Description	Serial
Location 1		
Svantek 971	Sound Level Analyzer	51818
Aco Pacific 7052E	Microphone	62522
Svantek SV18	Preamplifier	49561
LD CAL200	Calibrator	9512
Location 2		
RION NL-52	Sound Level Analyzer	821097
RION UC-59	Microphone	6064
RION NH-25	Preamplifier	21138
LD CAL200	Calibrator	9253

All equipment was factory calibrated within one year of the measurement date. Field calibrations were performed before the measurements and verified immediately after the measurements were completed. Measurement setups are shown in Figure B1 and Figure B2 and the locations are identified in Figure B3.

Figure B1. Location 1

Figure B2. Location 2

Figure B3. Measurement Locations



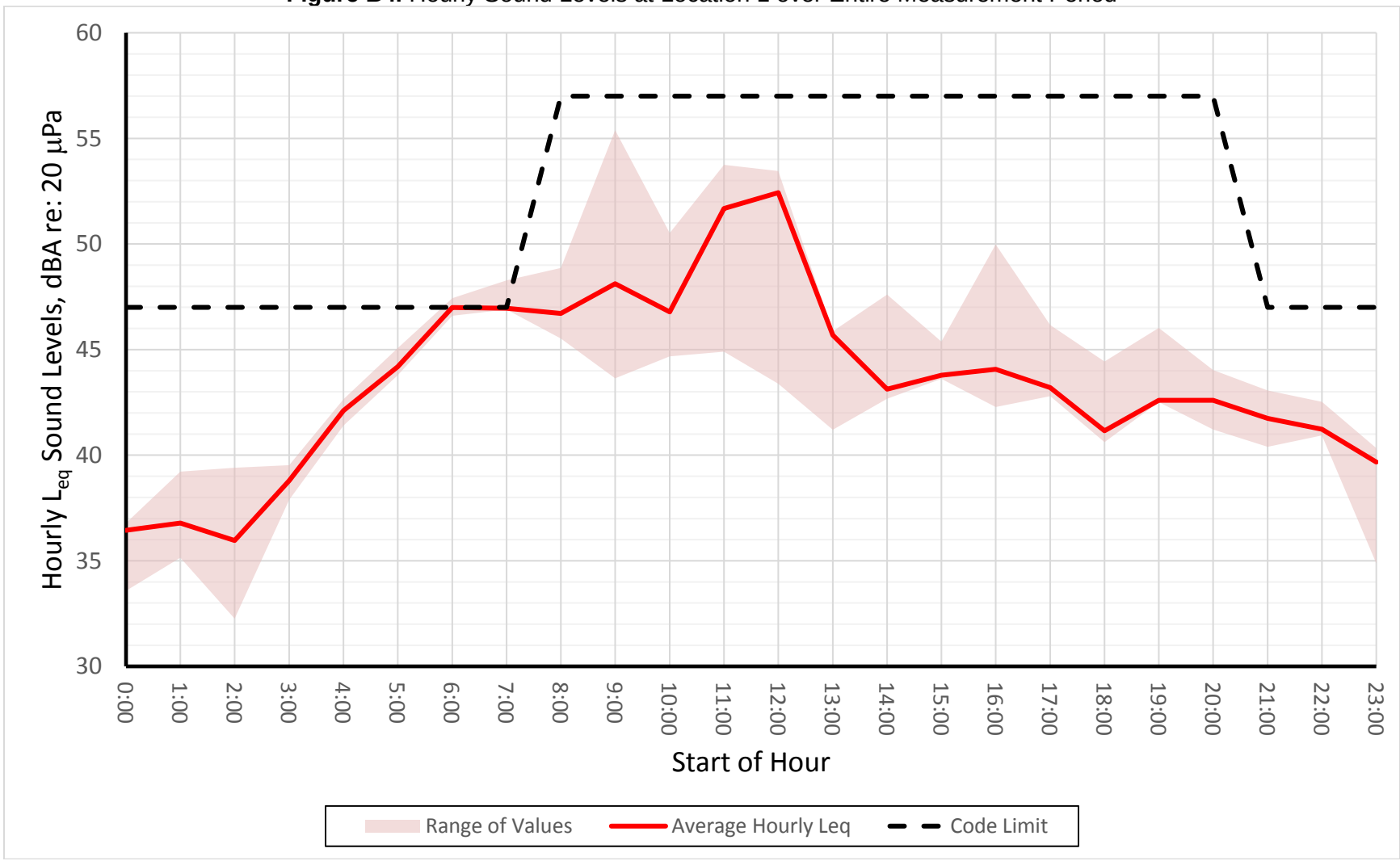
Sound levels at all measurement locations were below daytime and nighttime code limits. Measurement Location 2 at the south end of the property was louder than measurement Location 1 at the northwest side of the of site. This is likely because of the proximity of 228th Avenue Northeast. Measured sound levels are summarized in Table B2 and Figure B4 and Figure B5 below.

Table B2. Measured Hourly Sound Levels, Hourly L_{eq} dBA re: 20 μPa

Location	Low	High	Median[1]	
			Daytime[2]	Nighttime[3]
Location 1	32	55	45	40
Location 2	29	58	46	42

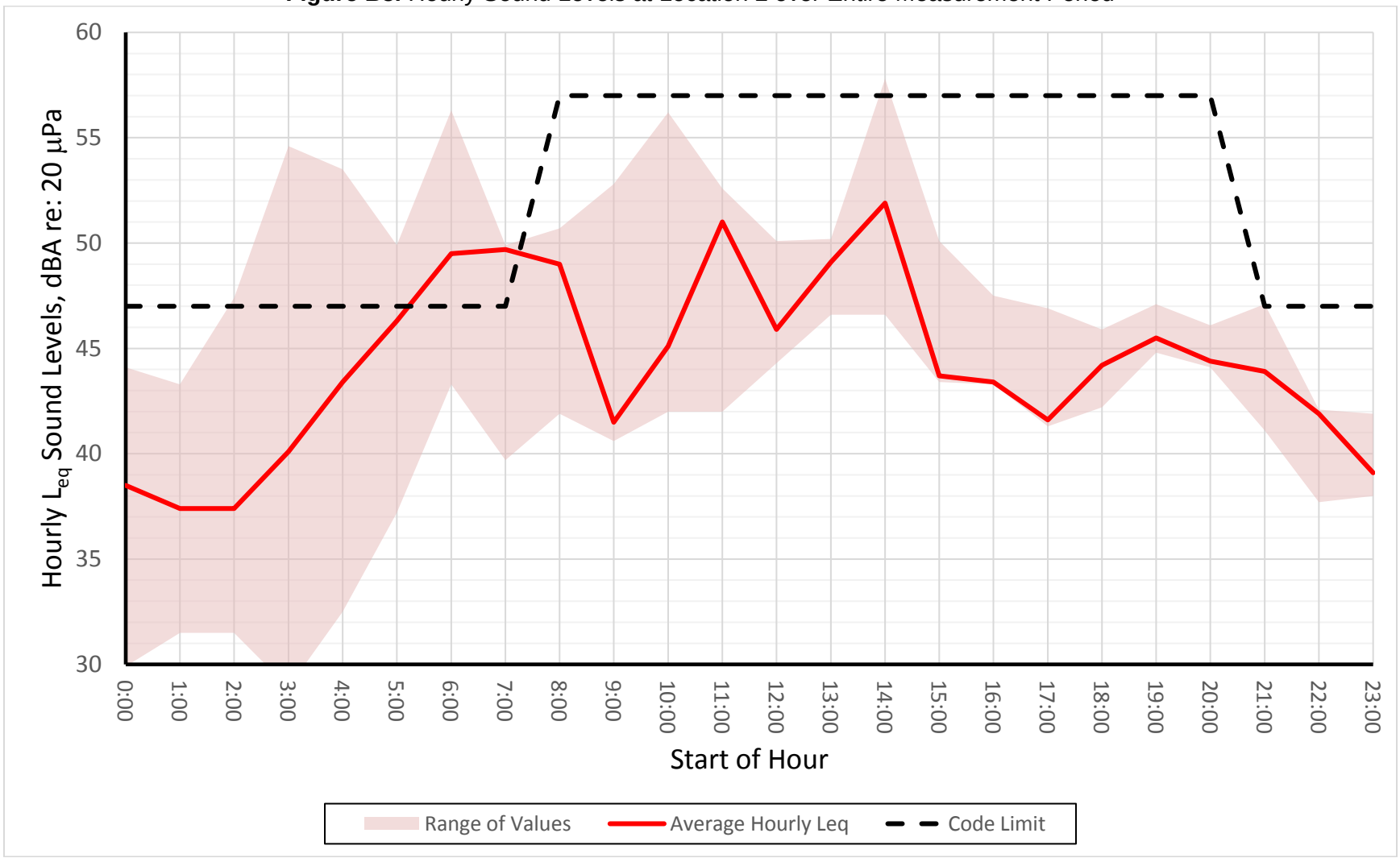
1. Median hourly L_{eq} values.
2. Between the hours of 7:00 AM and 10:00 PM
3. Between the hours of 10:00 PM and 7:00 AM

Figure B4. Hourly Sound Levels at Location 1 over Entire Measurement Period



Note: L_{eq} average is logarithmic average

Figure B5. Hourly Sound Levels at Location 2 over Entire Measurement Period



Note: L_{eq} average is logarithmic average